

Bedside Echocardiography In Patients With Hip Fracture

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ABSTRACT

Although surgery for fractured neck of femur is the highest risk among commonly performed surgery in medicine, there are very few data investigating treatment strategies to reduce the risk in this elderly and frail group of patients. Bedside echocardiography may be an useful tool to stratify surgical risk and optimize anesthesiology strategy. Echocardiography may help to assess a patient's intravascular volume status, myocardial contractility/ventricular ejection fraction and valvular heart disease in the peri-operative period. Careful patient selection based on multidisciplinary approach for pre-operative echocardiography is important to avoid unnecessary delay to surgery and at the same time to manage high risk conditions that may negatively affect the outcome of hip surgery. Larger studies are needed to establish the cost effectiveness of such approach.

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Key words: Echocardiography; Aortic stenosis; Hip fracture; Risk stratification

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INTRODUCTION

Hip fracture is one the most frequent causes of hospitalization in developed countries. In the European Community about 500,000 people suffer from hip fracture every year and not less than 70,000 cases /year are reported in Italy^[1,2]. More than 90% of hip fracture are observed in people aged >65 years and the risk doubles for every decade after 50 years Due to progressive ageing it has been estimated that the incidence will increase by nearly 60% over the next 20 years. One -year mortality is near 40% in comparison to 6.3% expected 1-year mortality in a healthy age matched population at time of fracture. In addition more than 60% of patients do not fully recover autonomy in basic daily life activities. Early surgery (within 24-48 hours from trauma) has been demonstrated to decrease 30-days and 1-year all-cause mortality in comparison to a intervention delayed > 48 hours (mortality decrease by 41% and 32%, respectively)^[3-5]. However these patients suffer from several co-morbidities and hospital mortality and morbidity rates ad long term results may be advantageously influenced by their careful evaluation and early treatment, allowing most of patients to benefit of early surgery and to limit postoperative complications. Comprehensive care is provided by multidisciplinary team prior to surgery has been reported to improve patients' outcomes^[6]. Bedside echocardiography may be an useful tool to stratify surgical risk and optimize anesthesiology strategy. Echocardiography may help to assess a patient's intravascular volume status, myocardial contractility/ventricular ejection fraction and valvular heart disease in the peri-operative period^[7,8].

GOALS OF ECHOCARDIOGRAPHY IN PATIENTS WITH HIP FRACTURE

Elderly patients with hip fracture may benefit from echocardiographic examination at hospital admission since it may give significant information useful in stratifying surgical risk and optimizing clinical status before surgery. Main information derived from echocardiography include: (1) Volume assessment. It may improve perioperative

conduction of fluid administration. Hypovolemia may adversely affect perioperative outcome; (2) Evaluation of left and right ventricular ejection fraction; (3) Assessment of significant valve heart disease (aortic stenosis, mitral regurgitation): this may lead to hemodynamic instability and influence anesthesia strategy; (4) Detect other conditions which may influence hemodynamics e.g pulmonary hypertension, pleural or pericardial effusion etc..

These information may be of vital relevance in frail patients who undergo a major surgical stress, leading often to change of anesthesia strategy^[9]. Nevertheless major concerns for echo examination regards the possible delay in surgery in patients undergoing echocardiography in comparison to non-echo patients^[10]. Shiga *et al*^[11] reported that hip fracture surgery delay beyond 48 hours increased the odds of 30-day mortality by 41% and 1 year mortality by 32%. However in their paper state that due to methodological limitations, definitive conclusions could not be drawn. Another study reported that there was no association between delay in hip fracture surgery and mortality after adjustment for medical co-morbidities^[12].

In 2001 the NCEPOD report^[13] recommended that 'whenever possible the anesthetist of a patient with aortic stenosis should obtain a preoperative echocardiogram of the aortic valve'.

In Sunderland Royal Hospital patients with a new diagnosed heart murmur underwent echocardiographic examination, that was performed by cardiology department of the hospital^[14]. Even if examination lead to change in anesthetic management in half of 29 patients examined (13 patients had surgery under general anesthesia, out of which 8 patients had an aortic valve abnormality only, 4 patients had both an aortic valve abnormality and mitral regurgitation, and 1 patient had severe mitral regurgitation), however delay to surgery in echo patients was on average 2.7 days in comparison to 1.1 days in non-echo group ($p < 0.001$). Thirty days mortality was not different in the two groups. Similar results have been reported by other authors^[7,15].

In the last decade different organization models have been proposed to improve outcome in patients with hip fracture, some including a more complex preoperative evaluation including echocardiography^[7-8,16]. At Derriford Hospital after demonstration of a significant delay in surgery in patients who needed echocardiography (average 5.7 days) when performed by cardiology service a routine weekday bedside echocardiography service was instituted^[7]. 374/501 patients admitted for hip fracture underwent echocardiography (most of patients lacking examination were referred in the week-end). Thirty-two patients (8%) had moderate- severe aortic stenosis. The authors demonstrated a clear dissociation between physical examination and results of echocardiographic examination although the presence of a murmur was associated with an increased probability of moderate-severe aortic stenosis (OR=8.5; 95% CI 3.8-19.5). In this model time to echocardiography was 1 day and average time to surgery 2.9 days. Venn *et al*^[17] demonstrated an earlier hospital discharge in hip fracture surgery patients who had their fluid treatment managed with intraoperative esophageal Doppler compared with central venous pressure monitoring. In literature only one study suggests that echocardiography may result in improved postoperative survival in patients with hip fracture^[18]. 64 patients who were considered to be at increased cardiac risk underwent pre-operative TTE. 12 months mortality was compared to a randomised cohort with similar cardiac risk who did not receive preoperative TTE. generated by randomly selecting patients from the hospital surgical databases. Mortality was lower in the TTE group over the 30 days (4.7% vs 15.2%, $p=0.047$) and 12 months after surgery (17.1% vs 33.3%, $p=0.031$). Hazard of death over 12 months was reduced after adjustment for known risk

factors (hazard ratio 0.41, 95% CI 0.2 to 0.85, $p=0.016$). Since 2011 in our third level teaching hospital an internal medicine specialist coordinates an integrated team (orthopedics, geriatrics, anesthesiologists) to safely decrease time to surgery, post-operative complications and the length of hospitalization in patients with hip fracture^[16]. Bedside echocardiography is easily available at hospital admission, being at least 3 members of the staff certified in performing echocardiography. Among 1025 patients referred for hip fracture between January 1 2012 and August 31 2103 focused echocardiography (new cardiac murmur, ECG abnormalities, history of heart disease, clinical signs of heart failure, hypertension) was performed in 460 (44.8%). Moderate to severe aortic stenosis (aortic valve area $< 1 \text{ cm}^2$) was found in 10.8%, moderate to severe mitral regurgitation in 24.5% and finally pulmonary hypertension (systolic pulmonary artery pressure $> 40 \text{ mmHg}$) in 28%. In non-echo patients time to surgery has been 2.33 ± 1.4 days. 72% underwent surgery within 48 hours. In patients who underwent echocardiography time to surgery was 2.52 ± 1.7 days and 71.9% were treated within 48 hours (Figure 1). Preliminary results suggest that in hospital mortality in focused echo-patients, despite more severe clinical conditions, are similar to age matched non echo patients (2.0 vs 1.5%).

AORTIC STENOSIS

Moderate or severe aortic stenosis is a significant risk factor for morbidity and mortality in patients undergoing non cardiac surgery. Severe aortic stenosis is associated with 4-10 fold increased mortality after non-cardiac surgery^[19-21]. The limited variability in left ventricular stroke volume associated with aortic stenosis impairs the ability to cope with hemodynamic demands from anesthesia and surgery. If not appropriately managed, cardiac output may become irreversibly depressed and cardiac arrest may ensue. Spinal anesthesia, commonly used in hip fracture surgery, may cause an uncontrollable decrease in systemic vascular resistance and precipitate hemodynamic deterioration. This mechanism may be amplified in high gradient low ejection fraction aortic stenosis.

Diagnosis of severe aortic stenosis should step-up level of anesthesiologists care and adjust the anesthetic technique to maintain cardiovascular stability however existing evidence are limited. Pellikka *et al*^[22] reported that surgery may not pose any additional risks for patients with aortic stenosis. Other authors^[7,23] reported a trend towards general anaesthesia versus spinal anaesthesia in hip fracture patients with varying severity of aortic stenosis; invasive monitoring was also used in some patients. A warning to the surgeon of high patient cardiac risk may prompt more efficient surgery and less blood loss and consideration of less invasive techniques.

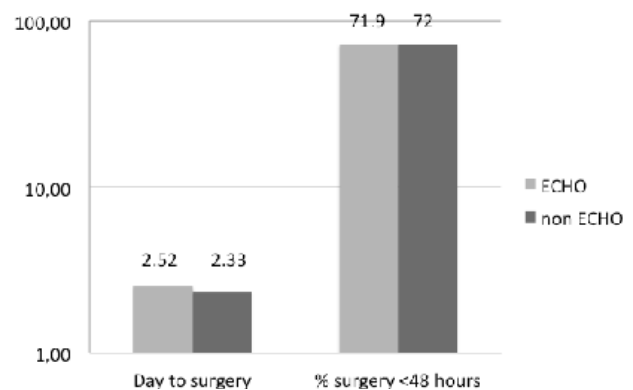


Figure 1 Time to surgery and percentage of patients undergoing surgery in echo patients in comparison to non echo patients.

The incidence of severe aortic valve stenosis (aortic valve area <1 cm²) in patients who need surgery for hip fracture is comprised between 5 and 10%^[24-25]. The few studies that examined the prognostic role of hemodynamic severe aortic stenosis on hospital and mid-term survival in in this frail group of patients gave contrasting results^[26-27].

Adunsky *et al*^[27] reported a two-fold increase of in hospital mortality (6.5 vs 3.2 %) in aortic stenosis (average aortic valve area 0.97 cm²) in comparison to patients without aortic stenosis. Balloon aortic valvuloplasty may allow to decrease pressure overload and decrease perioperative risk in selected patients that need urgent non cardiac surgery^[28-29]. ESC/EACTS guidelines suggest percutaneous treatment in patients who require urgent major non-cardiac surgery (recommendation Class IIb)^[30]. 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease report that "Most asymptomatic patients with severe AS who require urgent non cardiac surgery can undergo surgery at a reasonably low risk with anesthetic monitoring and attention to fluid balance. Percutaneous aortic balloon dilation is not recommended for these patients. If preoperative correction of AS is needed, they should be considered for AVR."^[31]. It must be stressed that hip surgery is associated with a high bleeding risk and TAVI is not a valuable preoperative option due to the need for anticoagulant treatment after valve implant. We recently reported uneventful hip surgery after balloon aortic valvuloplasty in two high risk patients with severe aortic stenosis^[32]. In our opinion symptomatic very high risk patients with aortic stenosis may still benefit by percutaneous interventional treatment, to decrease perioperative risk of hip surgery.

HYPOVOLEMIA AND HEART FAILURE

Approximately half of hip fracture patients who present for surgery are hypovolemic from bleeding, reduced oral intake, and a reluctance of medical staff to give fluids for fear causing pulmonary edema. Hypovolemia and cardiac failure is easily detectable with TTE enabling prompt and safe treatment prior to surgery.

TTE provides accurate intravascular volume assessment before surgery, allowing time for correction before anesthesia and surgery commences, which may help avoid hypotension and improve tissue perfusion.

By converse in patients with heart failure and increased pulmonary pressure diuretic treatment and careful fluid management may help to decrease the risk of perioperative pulmonary congestion and edema. Heart failure is associated with an higher in hospital and long-term mortality in patients undergoing surgery for hip fracture^[33-34]. Preliminary results from our institution suggest that preoperative pulmonary hypertension (estimated pulmonary artery pressure > 40 mmHg) is an independent predictor of in-hospital mortality in patients undergoing hip surgery (HR=9.5, 95% CI 1.39-12.9, *p*<0.01). At present limited experience has been reported on results of perioperative treatment in this two clinical conditions associated with hip fracture.

GUIDELINES

ESC guidelines on preoperative evaluation of patients undergoing non-cardiac surgery suggest that echocardiography should be performed before surgery in patients with heart failure (recommendation class I evidence level A) and in patients with suspected valvular heart disease (recommendation class I, evidence level C) while in asymptomatic patients rest echocardiography

undergoing major non cardiac surgery has a class IIb recommendation level C evidence^[35]. In guidelines for treatment of patients with hip fracture a population in in whom more than 20 % suffer from hemodynamic significant valvular disease, often concealed by misleading physical examination, and 15-20 % from heart failure, referral to preoperative echocardiography are limited. In 2009 SIGN guidelines suggested that echocardiography "should be performed if aortic stenosis is suspected, to allow confirmation of diagnosis, risk stratification and any future cardiac management"^[36]. The need for echocardiography however "should not delay surgery unduly".

The Association of Anaesthetists of Great Britain and Ireland (AAGBI) guidelines Management of Proximal Femoral Fractures 2011 suggest that "echocardiography may be indicated.... to investigate the severity of an ejection systolic murmur heard in the aortic area"^[37]. Moreover, for the first time, echocardiography is suggested to establish left ventricular function if the patient is breathless at rest or low level exertion. Evidence of these recommendations however is limited by the absence of systematic reviews, meta-analyses, or randomized controlled trails that evaluated the clinical utility of echocardiography in a hip fracture.

CONCLUSION

Although surgery for fractured neck of femur is the highest risk among commonly performed surgery in medicine, there are very few data investigating treatment strategies to reduce the risk in this elderly and frail group of patients. Careful perioperative multidisciplinary team evaluation and conduction may avoid preventable deaths in these patients. The exact answer to timing of hip fracture surgery is uncertain. Careful patient selection based on multidisciplinary approach for pre-operative echocardiography is important to avoid unnecessary delay to surgery and at the same time to manage high risk conditions that may negatively affect the outcome of hip surgery. Larger studies are needed to establish the cost effectiveness of such approach.

CONFLICT OF INTERESTS

There are no conflicts of interest with regard to the present study.

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